Fish Tissue and Sediment Toxics Evaluation

- **Fish Tissue (fish consumption use)**

The Water Quality Standards and Biological Monitoring Programs (WQSBMP) collects fish tissue samples from designated monitoring stations for contaminant analysis. WQSBMP staff identifies the results of any analysis that exceeds a screening value (SV) for the toxic contaminants and includes this information in the data provided to water quality assessment (WQA). Due to the delay between sample collection and final analysis results, fish tissue data for this assessment cycle will include samples collected in 1995 through 2000. Older fish tissue data may be included where deemed appropriate.

Fish tissue data collected at stations throughout Virginia represent Tier 1 monitoring data. These Tier 1 monitoring data are meant to identify sites where concentrations of contaminants in the edible portions of commonly consumed fish indicate a potential health risk to humans. Usually, three fish tissue composite samples are analyzed for chemical contaminants at each Tier 1 station. Each is a composite of edible fillets for one species of fish from a top-level predator, a mid-level predator, and a bottom feeder.

If Tier 1 results reveal potential problems, a more intensive Tier 2 study is initiated by WQSBMP staff to determine the magnitude, geographical extent, and potential sources of contamination in the fish.

Analytical results for fish tissue are expressed in wet-weight and are compared to screening values (SVs) for the toxic contaminants using EPA risk assessment techniques for noncarcinogen and carcinogen effects. SV calculations use the 10^{-5} risk level adopted by the State Water Control Board in 1992, an average human body weight of 70 kg and a lifetime fish consumption rate of 6.5 grams per day (general U.S. population), which are the same values used to calculate the human health water quality criteria found in 9 VAC 25-260-140.B. Also included in the SV calculation are toxicological data pertinent to human health effects; a reference dose (RfD) is used for non-carcinogen toxic effects and a cancer oral slope factor is used for carcinogen effects. Screening values shown in Table 6a are based on the same toxicological data (and body weight, fish consumption, and cancer risk level) that form the basis for the water quality criteria listed in 9 VAC-25-260-140.B, under the column labeled "Human Health, All Other Surface Waters". These water quality criteria are water column concentrations that are based on a specific fish tissue concentration, which were calculated to represent a safe or acceptable minimal risk level. The water quality criteria are designed to prevent the fish from bioconcentrating the toxic contaminants to levels greater than these fish tissue concentrations. The SV concentrations listed in Table 6a represent the same fish tissue concentrations that are the basis for the water quality criteria listed in 9 VAC-25-260-140.B and may be considered the fish tissue concentration equivalent of those water quality criteria. Table 6a contains SVs for all chemicals for which Virginia has adopted water quality criteria. However, many of the chemicals listed in Table 6a do not bioaccumulate and are not often found in

fish tissue. They are included in Table 6a for completeness. All screening values are rounded to two significant digits.

Table 6b lists SVs for additional toxic chemicals for which Virginia has not adopted water quality criteria that are based on fish tissue concentrations (those criteria listed under "All Other Waters" in 9 VAC-25-260-140.B). It includes chemicals recommended for monitoring by EPA or of special interest to DEQ as well as SVs for some chemicals that are based on recent changes to toxicological data and /or exposure assumptions that are different from those used to calculate the water quality criteria found in 9 VAC-25-260-140.B. The SVs in Table 6b are updated using available data from the EPA IRIS database and /or recommendations from EPA or the VDH before each assessment effort so the assessments are based on the most up to date information available on human health risks.

If a fish tissue composite sample exceed an SV in either Table 6a or Table 6b, the water body should be delineated as threatened for fish consumption. If the SV, listed in Table 6a for the same toxic pollutant, is exceeded in two or more samples from the same site, the water is considered partially supporting. For example, both of the following situations would qualify as partially supporting under this criterion: two different fish samples from different species during one sampling event or two or more different samples of the same or different species from different sampling events. Data from all Tier 1 and Tier 2 monitoring studies are evaluated by DEQ as well as provided to the VDH for their consideration of the need for establishing fish advisories. DEQ and VDH have signed a Memorandum of Agreement (MOA) that describes how the agencies exchange information regarding the results of all Tier 1 and Tier 2 fish tissue monitoring. If VDH issues a fishing ban or advisory, limiting consumption, the segment should be designated either partial or not supporting for fish consumption use based on the severity of the advisory. An advisory limiting fish consumption is considered partially supporting and an advisory prohibiting consumption is considered not supporting the fish consumption use. The results of the Tier 2 study should be clearly communicated in the 305(b) narrative.

Table 6a. RISK BASED SCREENING VALUES (SV) FOR FISH TISSUE BASED ON THE SAME TOXICOLOGICAL DATA USED FOR CALCULATING THE HUMAN HEALTH WATER QUALITY CRITERIA IN 9 VAC-25-260-140.B UNDER "ALL OTHER WATERS" FOR GENERAL POPULATION (ADULT)

BODY WEIGHT (KG)	70
RISK LEVEL	10^{-5}
CONSUMPTION RATE (KG/DAY)	0.0065

COMPOUND	CAS No.	Non Carcinogen Screening Value	Carcinogen Screening Value
		(wet weight) ppb	(wet weight) ppb
Acenaphthene	83-32-9	650,000	

Aldrin	309-00-2	320	6.3
Anthracene	120-12-7	3,200,000	
Antimony	7440-36-0	4,300	
Benzene	71-43-2		3,700
Benzo(a)anthracene	56-55-3		15
Benzo(b)fluoranthene	205-99-2		15
Benzo (k)fluoranthene	207-08-9		15
Benzo(a)pyrene	50-32-8		15
Bromoform	75-25-2		14,000
Butyl benzyl phthalate	85-68-7	2,200,000	
Carbon tetrachloride	56-23-5		830
Total Chlordane	57-74-9	650	310*
Chlorodibromomethane	124-48-1	220,000	
Chloroform	67-66-3		18,000
2-Chlorophenol	95-57-8	54,000	
Chrysene	218-01-9		15
Cyanide	57-12-5	220,000	
DDD	72-54-8		450
DDE	72-55-9		320
Total DDT	50-29-3	5,380	320
Dibenz(a,h)anthracene	53-70-3		15
Dibutyl phthalate	84-74-2	1,100,000	
Dichloromethane	75-09-2		14,000
1,2-Dichlorobenzene	95-50-1	970,000	
1,3-Dichlorobenzene	541-73-1	140,000	
1,4-Dichlorobenzene	106-46-7	140,000	
Dichlorobromomethane	75-27-4		1,700
1,2-Dichloroethane	107-06-2		1,200
1,1-Dichloroethylene	75-35-4	97,000	
2,4-Dichlorophenol	120-83-2	32,000	
Dieldrin	60-57-1	540	6.7
Diethyl phthalate	84-66-2	8,600,000	
Di-2-ethylhexyl phthalate	117-81-7		7,700
2,4-Dimethylphenol	105-67-9	220,000	
2,4-Dinitortoluene	121-14-2		350
Dioxin	1746-01-6		0.0062
Endosulfan (1 and II)	115-29-7	65,000	
Endrin	72-20-8	3,200	
Ethylbenzene	100-41-4	1,100,000	
Fluoranthene	206-44-0	430,000	
Fluorene	86-73-7	430,000	
Heptachlor	76-44-8	5,400	24
Hexachlorocyclohexane (lindane) or BHC - gamma	58-89-9	3,200	

Indeno(1,2,3-cd)pyrene	193-39-5		15
Isophrone	78-59-1	2,200,000	
Mercury (Methyl)	22967-92-6	1,100	
Monochlorobenzene	108-90-7	220,000	
Nickel	744-00-2	220,000	
Nitrobenzine	98-95-3	5,400	
PCB Total/congeners	1336-36-3	220	54*
Pentachlorophenol	87-86-5		900
Phenol	108-95-2	6,500,000	
Pyrene	129-00-0	320,000	
Selenium	7782-49-2	54,000	
Tetracholoethylene	127-18-4	110,000	
Toluene	108-88-3	2,200,000	
Toxaphene	8001-35-2	2,700	98
1,2,4-Trichlorobenzene	120-82-1	110,000	
Trichloroethylene	79-01-6		860
2,4,6-Trichlorophenol	88-06-2		9,800
Vinyl Chloride	75-01-4		6,200

* These screening values are based in EPA recommended cancer slope factors for these compounds which have been updated since DEQ adopted the water quality criteria. These screening values have been used by DEQ in previous years in assessing fish tissue.

Table 6b. RISK BASED SCREENING VALUES (SV) FOR FISH TISUE UPDATED FROM INTEGRATED RISK INFORMATION SYSTEM (IRIS) FOR GENERAL POPULATION (ADULT)

BODY WEIGHT (KG)	70
RISK LEVEL	10^{-5}
CONSUMPTION RATE (KG/DAY)	0.0065

COMPOUND	**CAS No.**	**Non Carcinogen**	**Carcinogen**
		Screening Value	**Screening Value**
		(wet weight) ppb	(wet weight) ppb
Arsenic (inorganic)	74440-38-2	3,200	72**
Barium	7440-39-3	750,000	
Benzene	71-43-2		2,000**
BHC alpha	319-84-6		20
BHC beta	319-85-7		60
Total BHC isomers	608-93-1		20
Brominated Diphenyl Ethers			5,000

(BDEs)			
Cadmium	7440-43-9	11,000	
Chromium III	16065-83-1	16,000,000	
Chromium VI	18540-29-9	32,000	
Chlorpyrifos	2921-88-2	32,000	
Diazinon	333-41-5	970	
Dicofol	115-32-2	11,000	
Dioxin	1746-01-6		0.003**
Disulfoton	298-04-4	430	
Ethion	563-12-2	54,000	
Heptachlor epoxide	1024-57-3	140	10
Hexachlorobenzene	118-74-1	8,600	70
Kepone	143-50-0	300	
Mercury (Methyl)	22967-92-6	300 (EPA 2001) 500 (VDH 2000)	
Methoxychlor	72-43-5	54,000	
Mirex	2385-85-5	2,200	
Oxyfluorfen	42874-03-3	32,000	830
PAH (sum PEC)***			15
PCB Total/congeners	1336-36-3	220	54
Terbufos	13071-79-9	1,400	
Toxaphene	8001-35-2	2,700	100
Tributyltin	56-35-9	320	
Selenium	7782-49-2	54,000	
Vinyl Chloride	75-01-4		72**

CAS No. = Chemical Abstract Service Number
ppb = parts per billion

** These screening values are based on recent changes to the toxicological data used to calculate the screening values, or recent recommendations from U.S. EPA or the Virginia Department of Health. These screening values are not based on the same toxicological data that were used to develop the existing water quality criteria.

*** Mixtures of seven polynuclear aromatic hydrocarbons (PAHs) that are classed as probable human carcinogens were assessed based on a screening value concentration of 15 ppb calculated as a sum potency equivalency concentration (PEC) using methods described in EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Vol. 1, (EPA 823-R-95-007) and Vol. 2 (EPA 823 B-00-008) using the following equation:

$$\mathbf{PEC} = \sum_{i} (\mathbf{RP}_i \times \mathbf{C}_i)$$

where; $\mathbf{RP}_I$ = relative potency for the ith PAH
$\mathbf{C}_I$ = concentration of the ith PAH in fish tissue)

The relative potency estimates used for these PAHs were:

Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.145
Benzo(b) fluoranthene	0.167
Benzo(k)fluoranthene	0.020
Chrysene	0.0044
Dibenz(a,h)anthracene	1.11
Indeno(1,2,3-cd)pyrene	0.055

- **Sediment (aquatic life use)**

Like the sediment monitoring and analysis conducted by Water Quality Standards and Biological Programs, the regional offices will assess the AWQM sediment data. Sediment contaminant data collected during scheduled AWQM monitoring should be compared to National Oceanic and Atmospheric Administration (NOAA 1995) effects range-medium (ER-M) SVs for sediment. If the ER-M is not available, use the VA 99th percentiles (Table 7). One or more exceedences of an ER-M value results in a fully supporting but threatened status for aquatic life use support. In these cases, additional biological monitoring should be scheduled to assess actual aquatic life use support.

Table 7 Sediment criteria for use in the assessment of aquatic life support.

- **Trace Elements –parts per million (ppm), dry weight**

Substance		**ER-M Value**	**99th %tile**
		Dry weight	dry weight
		Ppm	ppm
Antimony (Sb)		NA	
Arsenic(As)		70	
Beryllium (Be)		NA	5.0
Cadmium (Cd)		9.6	
Chromium (Cr)		370	
Copper (Cu)		270	
Lead (Pb)		218	
Manganese (Mn)		NA	
Mercury(Hg)		0.71	
Nickel (Ni)		51.6	
Selenium (Se)		NA	20.0

Silver (Ag)		3.7	
Thallium (Tl)		NA	13.5
Zinc (Zn)		410	

- **Pesticides and Other Organic Substances –parts per billion (ppb), dry weight**

Substance	**CAS No.**	**ER-M Value**	**99th %tile**
		Dry weight	dry weight
		Ppb	Ppb
Polychlorinated Biphenyls (PCBs)	1336-36-3	180	
Aldrin	309-00-2	NA*	
Total Chlordane	57-74-9	6	
DDD	72-54-8	20	
DDE	72-55-9	27	
DDT	50-29-3	7	
Total DDT (include metabolites)	NA	46.1	
Dieldrin	60-57-1	8**	
Endrin	72-20-8	NA	
Heptachlor	76-44-8	NA	
Heptachlor epoxide	1024-57-3	NA	
Hexachlorobenzene	118-74-1	NA	
Total BHC isomers Hexachlorocyclohexane	608-73-1	NA	
BHC gamma Lindane	58-89-9	NA	
Mirex	2385-85-5	NA	
Phenol	108-95-2	NA	
Di-2-ethylhexyl phthalate	117-81-7	NA	
N-Butyl phthalate	84-74-2	NA	
Acenapthene	83-32-9	500	
Acenapthylene	208-96-8	640	
Anthracene	120-12-7	1,100	
Benzo(a)pyrene	50-32-8	1,600	
Benzo(g,h,i)perylene	191-24-2	NA	
Benz(a)anthracene	56-55-3	1,600	
Chrysene	218-01-9	2,800	
Dibenz (a,h)anthracene	53-70-3	260	
Fluoranthene	206-44-0	5,100	
Fluorene	86-73-7	540	
Indeno[1,2,3-cd]pyrene	193-39-5	NA	
2-Methylnaphthalene	91-57-6	670	
Naphthalene	91-20-3	2,100	
Phenanthrene	85-01-8	1,500	

Pyrene	129-00-0	2,600	
Low Molecular Weight PAHs	NA	3,160	
High Molecular Weight PAHs	NA	9,600	
Total PAHs	NA	44,792	

- * NA implies not available
- ** (EPA proposed criteria)

PART IV DESIGNATED USES of VIRGINIA'S WATERS

The 305(b) process assesses a total of 5 designated uses, as appropriate for a particular waterbody, based on the Water Quality Standards. Assessed designated uses may include aquatic life use, swimming use, fish consumption use, shellfish consumption use and drinking water use. Swimming use is assessed to represent the primary and secondary water contact recreational use. Drinking water use is based on attainment of public water supply criteria. Following are details relating to the assessment of the five designated uses of Virginia's waters.

1. Aquatic Life Use:

Aquatic life use includes the propagation, growth, and protection of a balanced indigenous population of aquatic life (including game and marketable fish) which may be expected to inhabit the waters. Support of aquatic life use can be determined by the assessment of conventional parameters (dissolved oxygen, pH and temperature except in tidal waters); toxic pollutants in the water column, toxic pollutant analysis of sediments, nutrient analysis and/or the biological assessment of benthic communities. Normally, benthic assessments are the prominent aquatic life use determinant. However, all available data relative to aquatic life use shall be considered to determine if the aquatic life use is being threatened or otherwise being negatively affected.

2. Fish Consumption Use:

Fish consumption use includes the propagation, growth and protection of a balanced population of aquatic life including game and marketable fish. Support of this use is determined using two separate criteria. First, support or lack thereof, is based on human health related advisories and/or restrictions issued by the Virginia Department of Health (VDH). Impairment for fish consumption results when the public is advised by VDH that fish consumption is prohibited for the general population or there is an "advisory" that certain fish species should not be consumed by the general population or sub-populations

at greater risk, such as children and/or pregnant women. Second, the criteria used for fish consumption use is a comparison of fish tissue data to state screening values for toxic pollutants.

Any single observation above the screening value results in assessment of the water as fully supporting but threatened.

Two or more exceedences of a particular screening value listed in Section 6.5.2 Table 6(a) results in assessment of the water as partial supporting for the fish consumption designated use.

3. Shellfish Consumption Use:

Shellfish consumption use includes the propagation, growth and protection of a balanced population of aquatic life including marketable shellfish.
Support of this use is determined using the following criteria. The Division of Shellfish Sanitation (DSS) of the VDH bases support or lack thereof on a classification system designed for the harvesting and marketing of shellfish resources in accordance with Food and Drug Administration (FDA) guidelines. Four classifications are used to describe shellfish waters. They are approved, conditionally approved, restricted, and prohibited. ***Approved*** areas are waters from which shellfish may be taken for direct marketing at all times. ***Conditionally approved*** (seasonal condemnation) areas are waters where the quality may be affected by a seasonal population increase or sporadic use of a dock or harbor facility. ***Restricted*** (condemnations) areas are waters where a sanitary survey indicates a limited degree of pollution which makes it unsafe to market shellfish for immediate consumption. Shellfish harvested in these areas must be moved to an approved area for a certain length of time to allow for depuration before marketing. ***Prohibited*** (condemnations) areas are waters where the DSS sanitary survey indicates dangerous numbers of pathogenic microorganisms or other contaminants that impact the area. Shellfish cannot be harvested or relayed for purification in prohibited areas.

Shellfish waters where restrictions or prohibitions are due solely to a discharge outfall and not due to water quality violations will not be included in the 303d report. In these cases, monitoring should not be conducted as the shellfish designated use has been administratively removed through the issuance of a discharge permit. Additional information relative to shellfish use assessment can be found in Appendix D of this guidance.